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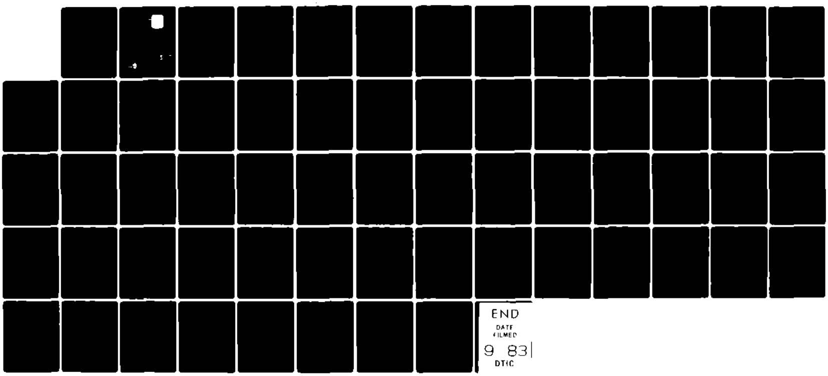

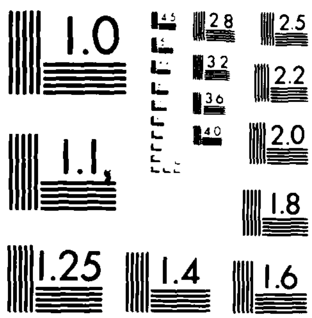


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# ENGINEER DIRECTIONS: AIRLAND BATTLE 2000

BY

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This study reviews the present trends of the US Army to the year 2000 and derives from these the implications for engineers on the AirLand Battlefield of 2000. The functions of Mobility, Countermobility, Survivability, General Engineering and Topography are considered in the environment of the ALB 2000 with attention to the resources, constraints, and tactics of the battle. The conceptual foundation of the engineer tasks is reviewed, together with their doctrine, organization, training, and materiel. From the implications derived
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in this review, a foundation for equipping the future engineer may be defined, and given the proper analysis, programed and budgeted. It is this latter task that we have not endeavored to do, leaving that task to the engineers of the Class of 1984.

USAWC MILITARY STUDIES PROGRAM

# ENGINEER DIRECTIONS: AIRLAND BATTLE 2000

GROUP STUDY PROJECT

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## ABSTRACT

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## PREFACE

This Group Study Project was produced under the aegis of the US Army War College and with the support of the US Army Engineer School. The project was designed to support a follow-on group study project for several engineer students in the US Army War College Class of 1984. The purpose of this study is to give the Department of the Army and Training and Doctrine Command force planners a planning document that looks into the future and provides a conceptual basis for developing the doctrine and materiel requirements of the future. The authors are grateful for the assistance of Major Archie D. Audrews, of the Carlisle Barracks Computer Center and Mrs. Terry L. Calderon of the Word Processing Center. Without their unselfish help this project would never have been completed!

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# INTRODUCTION AND OVERVIEW

## GENERAL

Engineers have made significant contributions to support our successes on the battlefields of past wars, and there is little reason to expect that their importance or impact will diminish in the future. Effective use of terrain (to include structures such as cities) has and will continue to be one of the key elements in deciding battle outcome. Manipulation of time through slowing down the enemy and speeding up our own ability to move on or get things to the battlefield similarly has had tremendous impact. Yet things are changing rapidly--technology, political relations, economic systems, social values, information processing and transmission--and it is not reasonable to expect that future wars will be fought as have those of the past. Hence, while not losing sight of the lessons of history, engineers must adapt and plan to perform in the battles of the future. It is crucial that engineers keep pace with the other elements of the combined arms team while seeking out new technologies, methods and ideas to accomplish better mobility, countermobility, survivability, general engineering and topography (M-CM-S-GE&T) battlefield missions.

## PURPOSE

This study examines the role of the engineer in supporting the commander on the battlefield of the year 2000. It attempts to highlight the M-CM-S-GE&T needs for that battle, from which directions and guidance can be deduced to formulate requirements and upon which to base changes to the way we equip and train for battle. While taking advantage of the many

recommendations formulated in the April 1981 M-CM-S Systems Program Review (SPR) and the Combat Support, Engineering and Mine Warfare Mission Area Analysis (CSEMW MAA), this review will attempt to project present trends into the future (year 2000) in order to focus the planner's horizon. Our hope is that a degree of realism can be injected into the requirements process which will enable the Army to gain the maximum possible effectiveness from its engineers.

## SCOPE

This review considers the M-CM-S-GE&T functions for engineer active and reserve components, primarily forward of the Corps rear boundary. Trends, and the implications of those trends, rather than specifics, are used because we felt that trends are meaningful for a document forecasting twenty years ahead.

## METHODOLOGY

All available draft AirLand Battle 2000 (ALB 2000) documents were analyzed and considered in order to develop the shape of the battle in the year 2000 and the engineers' contributions thereto. However, most of the ALB 2000 material appears to be much too improbable to be realistic for the year 2000. Thus, collective judgment and intuition became the final arbiter for future concepts. This held equally well for the analysis of present ways of doing business--the Army does not always do things as it says it does or intends that they be done--especially when it comes to translating the PPBES process into reality. From the differences between the Army as we see it today, and the Army as we view it in the year 2000, we can deduce the expected shortfalls in capability to wage war in that latter period. And therefrom we should be able to influence the planners

and programers to effect combat developments and doctrine to allow us to achieve success on the ALB 2000 battlefield.

## ORGANIZATION OF THE PAPER

Chapter I is a review of present trends, projected to the year 2000 with special attention to the implications of these trends for the engineer.

Chapter II reviews the way engineers are trained, organized and equipped now, with some realistic anticipation of the short term trends (POM years). It includes a consideration of doctrine, organization, training and materiel systems with respect to the engineer M-CM-S-GE&T missions.

Chapter III is the difference between the short term directions and present state of the art, and the implications of the future--the deltas between Chapters I and II. It delineates the gaps expected to occur in now capability if resources and efforts are not redirected.

Chapter IV recommends corrections to permit the future engineers to do their jobs in AirLand Battle 2000.

# CHAPTER I

## FUTURE TRENDS AND THEIR IMPLICATIONS FOR THE ENGINEER

To appreciate the needs for the engineer functions on the battlefield of tomorrow, one must first define as best as possible the nature of that battle--one must peer into the future and divine through some hopefully logical extension of the present what will happen by that time.

The purpose of this chapter is to examine the state of the engineer functions on the battlefield in the year 2000--what are they; do they sti exist as necessary contributions to the battle; or have the warps and changes of the nature of that battlefield and the men and hardware on it so altered the traditional roles and missions that the functions of Mobility, Countermobility, Survivability, Topography, and General Engineering cease to exist as we recognize them today?

To perform such an examination, one must split out the factors which affect the outcome of the battle and consider each separately. For each, then, one must project--predict--its course over the next twenty years and examine how it affects the nature of battle at the end of that time. In short--what are the factors, and what are the trends? From these, then, what are the implications for the M-CM-S-GE&T functions?

A note here before proceeding. A common occurrence in all writings of the future is one of two sets of hyperbole. In one, the author drifts off into a totally unrealistic and unfounded dream of impossible proportions--thus, in his prediction, one finds such things as foam disposable bridges on the battlefield, or particle beam weapons at the tactical level in the year 2000.

In the other set, we find no significant change whatsoever--things are largely the same, not much change has transpired at all. Things are done in much the same fashion, and the tactics, hardware, and other factors remain the same. Perhaps a few advances--or regressions--are permitted in this view of the future, but not many.

Of these two sets of views, our persuasion is toward the latter. We do not believe that, in the space of a mere twenty years before the millennium of 2000, a large or overwhelming change will occur in the way battles are fought at the tactical level. In defense of this view, consider the changes over the past twenty years in comparison to what was predicted!

## LIMITATIONS

This study has been bound by many of the same limits as was the April 1981 M-CM-S SPR. We are dealing forward of the corps rear boundary. Water production, now a Quartermaster function, is not addressed. Nor is power production included.

## DEFINITIONS

Mobility. The maneuver commander's ability to move on, over or through the ground or water. Mobility on the battlefield may be regarded as composed of several distinct elements:

Countermine: The detection, neutralization and marking of mined areas.

Counterobstacle: The employment of systems to reduce or breach obstacles.

Gap Crossing: The negotiation of natural or man-made gaps, whether wet or dry.

Combat Roads and Trails: The construction of these for movement and maneuver.

Forward Aviation Combat Engineering: The provision of construction support to aviation.

Countermobility. The blocking or delaying of the enemy. It consists of the elements of mine warfare and obstacle construction.

Mine Warfare: The employment of mine systems.

Obstacle development: The use of explosive and non-explosive systems to create obstacles to impede enemy movement.

Survivability. The provision of protection to forces through cover or digging. It is the alteration of the terrain to our benefit.

General Engineering. The provision of engineering support to the forces which is different from that falling in the categories above. It includes lines of communication (LOC) repair, logistic facilities support, production of construction materials, rear area damage restoration, and many others.

Topography. The portrayal in graphic or other forms of data necessary for positioning and navigation on or over the surface of the earth.

## THE CONSTRUCT OF THE BATTLEFIELD

How the battlefield is viewed--picked apart and examined and put back together again--determines whether the viewing is complete or not. It is the picking apart which determines whether all the pertinent parts have been examined. To arrive at an adequate construct, or model, or vision, or portrayal of the battlefield is not easy. Nor do we ever know whether our particular model is better than others, or even, indeed, adequate to the task.

There are many ways to consider the battle. In this review, the battle will be examined as an aggregate of actions within a framework formed of the environment in which it takes place. The battle tasks will be examined

for their relevancy at the time they must occur--not before or after. Thus, the factor of training, so critical to winning, is only important as it contributes to the winning at the time of the battle. It is not important for what it contributed prior to the battle.

The approach used in both the Missi‹‹ Area Analysis (MAA) and the M-CM-S Systems Program Review (SPR) was one in which the battle was examined as a set of functions to be performed on the battlefield. The approach used in both these analyses or reviews was a set of functions arrayed in a matrix against the elements of concepts, doctrine, organization, training and materiel. As we examined how we were to view the battlefield, it occurred to us that what was missing in these analyses was an incorporation of the environment itself. The battlefield is more than the sum of its dissected battle functions arrayed for review--it is rather in large measure this array taken <u>in the context</u> of the ground and the atmosphere--the weather--in which the battle takes place.

These factors, then, are at least the sum of

the environment,

the execution,

the commander and his plan,

his resources,

the mission,

the enemy,

intelligence about the enemy, and

morale and will.

How to best fit all these together to gain a full appreciation of the battlefield now and in the future? We determined that at the time the

battle opens, a certain array of actions and assets exist in the environment. These are, in their simplest form,

the mission,

the resources,

$C^3I$,

the tactics to be used, and lastly,

the constraints applying at the time the battle is joined. Each of these is discussed below.

The Mission: the task set to be done; it acts as both a definition of the job to be done and as a constraint on the commander.

The Resources: to be considered individually as they contribute to the implications for M-CM-S-GE&T in the future, they are:

The Time available, and the time it takes to act.

The Troops available.

The Hardware--the weaponry and support gear.

The Ground.

Sustainability.

The State of Training.

The will to win--the Morale.

$C^3I$: the "glue" that holds the the resources together, forms them up, and permits the execution of the commander's tactics. These are command, control, and communications. Intelligence, the fourth factor, is the way the enemy enters our model. We do not consider the enemy, per se, in the view of the future. At the time the battle opens, what enters the commander's consideration is not what the enemy actually is or how he is organized, but rather the commander's intelligence systems' portrayal of the enemy. Thus, the enemy enters our equation not as a force but as the way he is seen through our intelligence. For the future, then, it is the success

or failure of intelligence as the battle opens which must be examined for its trend and the resulting implications for the M-CM-S functions.

The Tactics: These are the ways the battle is executed. They may be viewed in a host of ways. Tactics are the execution of doctrine as tempered by the concept of the operation, the commander's organization and assets, and the constraints imposed. Tactics may be viewed as the way the thing is done. If the mission is the end, then the tactics are the means, and the elements of $C^3I$ are the link between the two. In the AirLand Battle, it is the tactical elements of INITIATIVE, AGILITY, DEPTH, and SYNCHRONIZATION that determine the battle outcome. Are these, then, the elements we seek to examine in tactics for their trends by 2000? We think these tend to be more the trends themselves than the elements determining the outcome of battle. Here, in tactics, one finds the battle functions: close combat, fire support, aviation and close air support, air defense, NBC, and combat service support. Each of these will be examined under the diagram heading above of tactics.

Our formulation of the battlefield, then, is a total of:

WHAT'S TO BE DONE; WITH WHAT; HOW and THE MEANS TO DO IT

It is informative in this review to consider that the elements of mission, resources, constraints, and to an extent, $C^3I$, are independent variables in a mathematical sense. They cannot be changed at the time the battle opens. What can be done, and must be done at that time is that the commander operates in the tactical sense to effect the outcome. Thus, the tactics are properly considered to be dependent variables in the formulation. How they--the pieces of close combat, fire support, and the like--are used will determine the direction of the battle. Having said all that, a word of caution: the battlefield of the future is one where independent variables may in fact be altered at the onset of battle. Consider, for

example, the weather, where weather modification could be a factor. And, of course, it is the business of the combat engineer to alter the ground.

## EXAMINATION OF TRENDS AND IMPLICATIONS

The examination of the trends and implications will proceed along in the fashion of the discussion under the construct above; thus we will start with the mission, go to the resources and constraints, and into the elements of tactics before closing with the factors of $C^3I$. IT IS IMPERATIVE TO RECALL HERE THAT WE ARE DEALING WITH THE TRENDS OF THE WHOLE COMBINED ARMS TEAM. When the implications are discussed for each of the factors, they will be enumerated under the various categories of mobility, or countermobility, and so on, as is relevant to the particular implications.

## THE MISSION

### Trends

The nature of the mission on the battlefield of tomorrow will not change in a significant way. It really never has through history. It remains the execution of the political aim through combat with armed forces. However, the location, and thus the tactics used to accomplish the mission clearly appears to be changing already. We will be preparing to fight in locations far different than we have thought possible recently. The changing balances of world power can only lead us toward a more disparate, multi-polar, and uncertain world. We must be ready to go far afield, on little notice, and with little or no support in theater upon arrival. It has been noted that the most likely war will be the least intense, and the least likely war the most so. Perhaps. But clearly "go anywhere" is the watchword. So, the mission of tomorrow will mean going on short notice; going where we least expect; going to any of a multitude of diverse and

hostile environments; and having little if any support infrastructure on arrival.

## IMPLICATIONS

### General

Strategic deployability is a must for the entire combined arms team and all supporting elements. Since it is unlikely that there will be larger and more capable aircraft to move this force, the force must be designed to the aircraft--light and sized to permit loading without major teardown. The force must be capable initially of self-sustainment through its own capability, or there must be pre-positioned sustainment stocks. Since it is noted already that one cannot adequately predict where the battle will occur, then it seems reasonable to assume that it is wasteful, and therefore unjustifiable, to stockpile sufficient assets for every contingency. Therefore, one assumes the need for organic capability. What, then, does this mean for the engineer?

### Mobility

In areas where the infrastructure is poor--many in the Middle East, for example--work on LOCs will be critical. A force deployed with the requirement for self-sustainment noted above will necessarily have enormous logistical transport requirements within the theater necessitating large land supply movements. Not only must the LOCs often be built to start with, but they must be maintained, an awesome requirement. This means that our engineers must be both strategically deployable and have the capability in spite of that to get the construction work done. The needs for strategic deployability and construction capability are often exclusive of mutual satisfaction. Engineer equipment, to be effective, needs weight, and this

denies portability. Additionally, speed in movement is demanded. And, when the engineer is working to clear the way, he needs protection adequate to the task should he come under fire. So the engineer needs three S's--Speed in moving and doing, Strategic deployability, and, importantly, Survivability when he arrives to do the job. In each of these factors, he needs at least a set of characteristics compatible to the force he supports. This set of implications deriving from the trends will appear again and again.

<u>Countermobility</u>

We have seen that we need a light force capability in this mission for tomorrow. Light forces deployed against an enemy will demand the ability to block, delay, channelize, disrupt, and do anything in their power to slow him down to permit friendly targeting and maneuver time. The engineer helps to provide this countermobility through the creation of obstacles. Obstacles, whether they are mechanically constructed of earth and other materials or dynamically created through the use of mines or explosives, now require extensive and weighty supplies. Thus, again, either we have pre-positioned these before the battle is joined, or we must move them. One further option exists, and the unattractiveness of the others--construction, mines, or the like--makes it key for the future. We need to develop and field a light, safe, and powerful explosive. This would eliminate the extreme weight and bulkiness so necessary today. This is particularly true in dealing with light force contingency missions.

<u>General Engineering</u>

The lack of the infrastructure inherent in the places where the future missions may occur dictates an enormous requirement for general engineering. The need for depots, airstrips, combat service support facilities, oil and water transport networks, and the like tax the imagination. Certainly

such construction assets are not available in the force today. Two solutions beyond building a military force to do the job are possible. One is to maintain a strong internationally-experienced American contractor base in being through continued military construction efforts abroad. The ongoing work in Egypt and Oman comes to mind. The second is to identify--in advance and on a worldwide basis--the assets for these construction requirements which exist and then plan their contingency use as required. This in the form of Host Nation Support.

### Topography

The world-scattered nature of the mission requires of our topographers a single and enormously important thing: accuracy and timeliness of products. This may be achieved in the future through a quick response capability built into the topographic community, or a much-expanded stock of continually updated products on a worldwide basis.

## THE RESOURCES--TIME

### Trends

The battle in the year 2000 will be fought perhaps more quickly than we presently have the capability to react to. That demands a quicker reaction capability. If we have less time, then we need to be quicker--or we lose. Continuous battle is likely--taxing and wearing down the will to win, or even to resist defeat. Thus physical and structural endurance is important--more so than today.

## IMPLICATIONS

### General

Quickness of action is clear. Endurance is clear. Another, and equally, if not more critical need is to manage time better. This implies the need to finely hone and and well tune the sequencing of essential battle actions with each aimed to the cause and timed to occur at just the precise moment and in the precise duration. This saves energy and resources. Lastly, the need to gain time by delaying enemy action is fundamentally important.

### Mobility

Quickness of movement and maneuver is required, else there shall be no quick reaction. Mobility over the ground or water can be structured into the combined arms team equipment or it can be provided to it through adequate combat engineer support. The clear trends today are not toward structuring mobility into the force, with the exception of the Abrams tank and Bradley Fighting Vehicle. And even here, there is no organic swimming capability for negotiating water obstacles. Thus, while speed is built into these items, true total mobility is not. The implication for the future is clear. Combat engineers must be equipped to provide mobility support to the combined arms team quickly, reliably, and survivably. Again, we find the need for speed, strategic deployability, and survivability--or $S^3$. The combined arms force needs more than ever the capability to move in stride and under fire--without delay--toward the objective.

## Countermobility

Delaying the enemy assumes large importance if we are to gain time. This requires an ability to emplace obstacles quickly in the manner discussed above under mission. Essential for the future is the ability to use dynamic obstacles, which could be viewed as light--thus not so transport-consuming as are the current mines and barrier materials--switchable on or off, and very powerful. We must find a way to escape from the curse of the enormous class IV and V transport requirements which, if continued, will not permit our exercising a countermobility capability adequate to allow us to win the battle. Another related need is the ability to emplace obstacles more deeply and accurately than we now can. A dynamic obstacle capability combined with the delivery means for it is mandatory if we are to win the AirLand Battle.

## Survivability

Time--and its absence--implies clearly, and once again, the need for speed in moving and doing. For the light force in particular, protection of its fighting and command and control capabilities is necessary. To an extent, the speed with which the force is capable of moving offsets the need for digging protective shelters, or otherwise fabricating them. But no force--at all times and in all circumstances, will always be free of the need for protection assistance. Thus the requirement for hastily-provided protection. This means better diggers and lighter prefabricated shelters.

## General Engineering

Again, quickness in doing the tasks which have traditionally required a great deal of time to complete is needed. For engineers, this means that we must speed up our capability to construct--this is very slow as opposed to our capability to destroy, which is reasonably fast. An example of such

slowness is airfield construction and repair. Another is the building and constant maintenance work on LOCs.

### Topography

As in the above discussion of topography, quickness and completeness are needed. This means either quick production response or extensive prestocking--and prestocking at the unit level where the products are needed. There will be no time to move the products!

## THE RESOURCES--GROUND

### Trends

Simplistically, the ground doesn't change. It doesn't have a trend. But the way we can use it does. This use of terrain remains key to the execution of the battle tactics. It remains the thing we fight on or over. It remains the central focus of the engineer's task--how to fix it so it helps us and hinders him. From the points before made, it is clear we will need to alter it more quickly.

## IMPLICATIONS

### General

That we will be able to alter more quickly the ground in the future is apparent, although to what degree and at what speed remains a question. Another imponderable is the degree to which the force as a whole may be structured and equipped to ignore the ground. By this we mean the ability of the force to move and maneuver over the ground independent of its character--whether swamp or rocky mountain. If this ability is built into the materiel of the combined arms team, then much of the engineer mobility task becomes irrelevant. But it is our opinion that this will not be the

case by the year 2000, nor, for that matter, by twenty years beyond that! In support of this thesis, recall the swimming discussion above. How much of our current or projected hardware is capable of organic, unsupported fording or swimming operations?

## THE RESOURCES--THE CLIMATE, OR WEATHER

### Trends

Weather, in the sense of bad weather, has profound effects on troops and equipment and hence the battle outcome. There may be seen a trend to the use of weather modification as a weapon in the future. It has awesome potential and import. Its effects cannot be predicted with accuracy. There have been international efforts to outlaw its use as a factor. Not considered weather modification, but relevant to the review at hand, is the use of obscurants to block or fog the atmosphere through which we see optically and electromagnetically. The degree to which a force is capable of hiding in an obscured posture clearly reduces the need for survivability measures such as revetments, holes, or berms, and thus reduces the engineer effort required for this time-consuming task. Offsetting all this is the counter-obscurant technology, or "seeing" technology, which brings us full circle back to where we were--that is, needing the engineer to provide the force a measure of survivability. Additionally, the effect of this seeing-not-seeing course into the future will have important implications for the area of countermobility. It could reduce or increase its requirement according to which technology becomes ascendant.

## THE RESOURCES--TROOPS

### Trends

We will fight outnumbered. While this phrase is much overworked, it remains central to our look into the future. It is also said that we are brighter and quicker than the enemy, and implied that this will remain true into the future. It is our opinion that this is wishful thinking which could lead to a dangerous complacency in the way we program our actions for the future. It is inconceivable that we are producing, by some natural law, youngsters who are brighter than those in other lands. And, increasingly, the quality of public education we are giving our youth is suspect. Therefore it would be folly to rely on a false sense of a quicker native wit, which has no place in reality. Now, it may be said fairly that we shall have a youth better conditioned to the edge of technology--having been bred and nurtured in the electronic arcades, and increasingly, on home computers.

## IMPLICATIONS

### General

Granting the better-accustomed youth to the technology of computer-assisted gadgetry and the concomitant edge its use could present on the battlefield, it is clear that we need to press quickly to exploit this ability. We need to automate for speed and for saving limited manpower. Additionally, and importantly, we need to guard against the psychological pressure to "dig in for survival." While we are outnumbered, that does not reduce the need for maneuver and shock action. It increases it! The battle goes to the bold.

## Countermobility

Fighting outnumbered means delaying and blocking the enemy to permit our own maneuver. Therefore, countermobility becomes absolutely essential in the battle of tomorrow. Also, being outnumbered implies a need to do things with more agility--and quicker. Thus, this factor multiplies the importance of the time factors discussed above.

## Survivability

Keeping in mind the need to move, we will still require survivability in the battle where we are outnumbered in troops and equipment.

# THE RESOURCES--HARDWARE

## Trends

Most projections into the future have been focused on this area--and understandably, since the most visible changes will most likely occur here. But, we should note, these changes may not be the most profound. Those could be reserved for tactics or training. Changes in hardware will fall in several broad areas. There is the possibility for more organic "going" capability--as distinct from the inherent mobility discussed earlier. Going is the capability to move over diverse soil types with an unassisted ability; it is the organic inherent ease of movement as opposed to the ability to breach obstacles and minefields. In this sense the force is likely to be more maneuverable. The most valuable payoff from such a changed capability would probably accrue to the combat service support organizations, whose needs for mobility support consume enormous engineer assets. Tomorrow's hardware will be faster--today's is getting faster all the time. The Abrams and the Bradley are the most renowned examples. It will be much more complex, but yet more easily maintainable--perhaps.

Complex, yes; maintainable, hopefully. There are those who project that it shall be lighter--the court's out on that. It needs to be lighter, to be sure, but the trends continue to resist that need. More easily operated? Yes. And it shall in some cases be expendable. Most importantly, it shall be intensely lethal--on both sides of the forward line of troops (FLOT). Living will be very difficult. This issue of survivability on that battlefield is profound. Enhanced lethality implies greater dispersion, and possibly, fewer maneuver systems--in the sense of less numbers of them. It additionally implies that more protection is needed. Does this really mean that we can believe our hardware will be lighter?

## IMPLICATIONS

### General

From the above discussion, the implications for the entire combined arms team, and the engineer in particular, are severe. If our hardware is to be lighter, then much more protection will have to be furnished it--that means digging support at a minimum. On the other hand, if it is to be heavier, as noted above, then the mobility support requirement will be greater than today.

### Mobility

If the equipment on the battlefield will be more maneuverable--have better going ability--the impact will be favorable on the diminished support required of the force engineer. But, conversely, this implies that we will reach obstacles faster--and therefore need more counterobstacle and countermine support! Surely the engineer needs compatible speed and survivability--our $S^3$ again. Additionally, any tradeoffs gained from inherent combined arms team going improvements are absorbed by the increased needs

of the combat service support elements, unless they too will have better moving ability as posited earlier. Another critical area--so important that it stands alone--is in the countermine arena. While it is projected that the combined arms team, and the combat service support elements for that matter, will have organic countermine capability, it seems doubtful to us that this will occur by the year 2000. Thus, the combat engineer will be very busy clearing the way through minefields on that future battlefield. In sum, the most likely situation appears to be that the engineer will be more necessary, rather than less, on that battlefield.

Countermobility

Will the need for countermobility support be reduced in the future? It could be forecast so, for the organizations will be faster, and thus perhaps able to move to thwart the enemy maneuver rather than having to rely on obstacles. But we deny this supposition, feeling that because the enemy is also quicker, our advantage is relatively offset. Therefore, we will continue to need obstacles, as was discussed earlier. And, importantly, with our doctrine calling for deep ground thrusts into enemy territory, the need for flank protection will be critical. Again, this argues for a countermobility capability that is light, transportable, and effective--in short a dynamic obstacle-emplacing ability. Mines with this characteristic exist now. Other obstacle-producing hardware systems need to be developed--such imaginative things as projecting wires, for example, which would entrap moving troops or materiel on remote command.

Survivability

Here we have a potentially reduced requirement, but, as noted above, this is arguable. A survivability capability remains absolutely essential at the battle onset, when we must survive the surprise blow and go on to

win. Additionally, if our hardware becomes lighter, then it will need more, not less, survivability support.

### General Engineering

The future battlefield will, for all the reasons expressed earlier, have a large construction support need. Offsetting this in the future hardware category would hopefully be the trend to disposables--use and discard materials. Should this extend to expendable building materials, the impact of more needed support could be somewhat balanced.

### Topography

The clear impact of future hardware developments is already apparent. Digitization allows enormous information-handling capability--so necessary to store, retrieve, and move or distribute maps and map-like products. The future provision of topographic information will be by automated digital-handling equipment.

## THE RESOURCES--SUSTAINABILITY

### Trends

The future is not rosy. The trends are toward more needs, not less. Complex, more fragile hardware, in spite of the logisticians' protestations to the contrary, will require enormous support. There will be a greater diversity of supply needs--this occurs already as hardware with new fuel requirements appears in the inventory. Too, the policing of the developmental system in its production and introduction of hardware to the field in this regard has not been good. We believe this trend will continue. And it is not a problem just for fuels, but for all support items. The implications for the engineer are dire.

## IMPLICATIONS

### General

An enormous increase in construction and LOC work will occur, if the trends hold true. For critical contingency areas, as discussed earlier, there will be large pre-positioning construction requirements to prepare ahead for the first day of battle.

## THE RESOURCES--TRAINING AND WILL

### Trends

Little of substance can be predicted here, except that they will be even more important to battle outcome than they are today, as was noted above in the section dealing with the soldier.

## THE TACTICS

We move now to the way the thing is done--the manner in which the battle is executed. This is tempered by the resources available to the commander and the elements of $C^3I$ which he uses to arrange his assets to a winning combination; the "glue" of the earlier discussion. We decided above to break the elements of tactics, for our purpose, into the battlefield functions of close combat, fire support, aviation and close air support, air defense, NBC, and combat service support. We will begin, then, with close combat, which shall be divided into its light and heavy components.

## CLOSE COMBAT (LIGHT)

### Trends

The need for a lighter force was discussed above--it stems from the assumption that the airlift capacity will not significantly improve. It

will be operating over vast areas in remote sites--far from adequate support. It must be strategically deployable, or it simply won't get there. It will possess the factors enumerated above under the resource section.

## IMPLICATIONS

### General

Terrain as a combat multiplier is desperately essential to the light force elements. The need for engineers is therefore clear. The supporting engineers will have to be as light as the force they support else they will not go to the battle. This is a problem, for the equipment which needs to do the demanding job of terrain alteration is normally heavy--it must be so to do the work. Hence the discussion above about the necessity for other solutions to moving earth--for example explosively rather than mechanically. The light force will be dispersed. So must therefore be the engineers. Since this force will be capable of rapid dispersion--and subsequent rapid concentration--so must the supporting engineers. This need for decentralized engineers will be paramount. Traditionally, the engineers have held that, to insure adequate management of scarce resources, they must be under centralized control. No longer can this be so. When a dispersed combat unit encounters a minefield under fire, it will need its engineers immediately, not when they can at last arrive after dispatch from some other location. The provision of survivability support will be essential. The need for agility will be largely satisfied by technological enhancements across the force as a whole but this is not necessarily true for the engineer, whose needs have lagged behind the other combat arms in being satisfied. Another key area in the future for light forces is military operations in urban terrain, or city fighting, called MOUT. The need for the combat engineer in this endeavor is evident--obstacle breaching, rubble

clearing, and the like will be needed. So also will the provision of "three dimensional" topographic information--plans and maps of building interiors, underground passages such as sewers, and utility information on a large scale.

## Mobility

Light forces highlight the requirement for countermine and counter-obstacle tasks--largely because these tasks are perceived as, and are, so difficult to execute with equipment tailored to meet the deployability criteria of lightness. Providing support to a light force moving through a minefield--under fire--is a tough problem. Here again is the vexing problem of compatibility: how to have organizations and hardware meeting the conflicting, and perhaps mutually exclusive criteria for durability and strength in doing, and lightness and flexibility for moving. For mobility itself, there is a possibility that movement support could be reduced. Light forces, with great distances to cover, lend themselves to air movement, and thus to not needing the ground mobility support traditional to land forces. But this implies the need for more aviation engineer support--airfields, heliports, and other facilities. So once again, an advantage gained in one place is offset by another requirement. And there remains the problem of gap-crossing under fire with rafts or bridges that are adequate to the task and yet transportable with the light force.

## Countermobility

This function, as mentioned previously, is key to the light force. There will be a critical need for delaying or blocking the enemy to preclude his bringing his heavier forces to bear on us. This demands the ability to emplace obstacles with blocking power quickly while under fire--thus the need for dynamic obstacles. Additionally, flank protection will be

essential. For all this, digging is not the answer. Engineers will need the capability to emplace obstacles rapidly with or without the use of earth.

## Survivability

As noted, this is key to the success of the light force. Where possible, however, it will be essential to obtain survivability through means other than digging in. The kind, weight, and general nature of digging equipment does not lend itself to the light forces. For digging, the engineer will need dynamic, or explosive, digging assets. That said, the way to survive is to depend on non-digging means. The use of obscurants, mentioned earlier, is one such way.

# CLOSE COMBAT (HEAVY)

## Trends

Extreme havoc on a devastated field of battle will be commonplace in the central battle between heavy forces, whether the fight is nuclear or conventional. Severe disruption of all lines of transport--from front to rear--is to be expected. The heavy force will be characterized by deep operations in swift strikes, bypassing where possible the obstacles created, intentionally or not, by the lethality of the weaponry engaged. Forces will operate away from support--engineers will have to go with them or be built into the force. This latter is so unlikely in our view that it may be dismissed. The heavy force will not have any more organic swimming capability in it than it does today--and that is virtually nil. Logistical support will be enormously increased--much of this will be in the area of munitions storage and movement forward. There may be organic digging capability in the forward units--this is essential, but limited procurement and

the competition for scarce resources will make this problematical. One need is so paramount that it must be assumed to be present in the 2000 force--tightly linked and well trained combined arms togetherness on the battlefield. It is not our view that the heavy force will be any more agile than the current force--enhanced as it is becoming with the Abrams and the Bradley. Indeed, it is very probable that the force will become heavier rather than lighter--one recalls the bureaucratic battle over the DIVAD system as it gradually rivalled, then exceeded --the weight of the main battle tank. The clear trend is toward heaviness, not lightness, in spite of ardent protestations to the contrary. This has dire meaning to the capability of engineers to provide mobility support to the force.

## IMPLICATIONS

### General

The general implications for the engineer from the directions the heavy force seems to be moving are significant. Engineer capability will have to be dispersed, capable of rapid moving and doing, and as survivable as the force it is meant to support. Most critically, the capability to provide mobility support--breaching minefields and obstacles under fire--is currently lacking and it is our view that this will probably continue into the future. Only on that first future battlefield will its lack be really noticed. The provision of this capability to the force today does not enjoy the priority necessary to meet with funding. This situation is not likely to change with time. We need the capability, for example, offered by the counterobstacle vehicle concept. But it is extremely unlikely that such a system will ever enter the force. An even more pressing problem, and one that is universally recognized, is the lack of any realistic countermine breaching capability. This vexing predicament has not admitted to

technology's thrusts, nor does it appear likely to. And, in the meanwhile, mines become more pernicious every year. The solution of robotic breaching--to avoid the psychological problems--appears to be the best one evident, but it is nothing new in technology at all. It is simply automating the age-old bulling-through technique and supplementing it with line charges. Lastly, the problem of the desolation on that central battle ground cannot be overstressed. The total waste will be incredible and is unimaginable in scope. To move through such an area is the potentially biggest engineer challenge of all--to prevent the bogging down of our maneuver elements in obstacles.

### Other

The areas of countermobility, survivability, and general engineering are much the same in what they will be tasked to provide as has been mentioned before. Dynamic obstacles, digging for survival, and increased logistical requirements for engineer support are primary for the heavy force.

## FIRE SUPPORT

### Trends

More accurate, more devastatingly powerful, and more volume all characterize the element of fires on the future battlefield. These factors are emerging already, and may be expected to continue to move in the direction stated. The element of lethality is key. The improved accuracy, volume, and sheer energy of the weapons cannot be overstated. Their use renders the battle a chaos of devastation, and make survival itself an enormously important function. The issue of how the artillery elements assure their own survivability is unresolved at present. Two ways are clear--to move or

to dig. It is the relative balance between them which determines the structure of the supporting engineer force, or, indeed, whether the artillery themselves should have organic digging or other protective means. Of the two, movement is the clearly preferable one. But movement for an artilleryman implies not firing--the two are mutually restrictive. An additional important trend deriving from the increased volume of fire is the swelling logistic tail and the provision for its movement and storage. One completely new, and undoubtedly growing, factor in this increased volume is the artillery-emplaced mine. The requirements in volume for these dynamic obstacles could easily overwhelm the fire capability on the battlefield.

## IMPLICATIONS

### General

For the engineer, the key tasks in supporting the artillery will be provision of survival--digging protective positions--support and assisting movement through clearing obstacles--mobility, and clearing supply routes to insure the continued flow of the necessary munitions.

### Mobility

Whether survivability for the artillery is derived from movement or digging, the engineer task will be bigger than it is today. Either more mobility support will be required, or more digging. Too, the artillery will need more mobility support in any case for they will be up front on the deep strike missions.

### Countermobility

As noted above the key implication here is the growing use of the dynamic obstacle-producing scatter mine. The balance between it and the

conventional artillery munitions will have to be carefully watched as tactics and use are defined through emerging doctrine.

Survivability

Noted already; it will grow in importance in our view. Revetments, possible overhead cover, and digging in are going to demand tremendous numbers of diggers--or extremely fast ones, on the order of the Combat Emplacement Excavator conceptualized in the SPR Hardware Handbook. The Soviets have such a capability already.

Topography

Organic positioning capability will reduce the need for traditional topographic support to the artillery.

## AVIATION AND CLOSE AIR SUPPORT

Trends

More! There will be more aviation activities on the battlefield than we can even imagine today, in spite of the increased lethality of the battlefield. More movement of forces by air, more weapons-platform provision by the air assets, and a large increase of movement of logistic support by air. In this last, consider the requirement to preposition supplies along the deep strike routes, which are so characteristic of the AirLand battle, and the use of robotic aerial vehicles, particularly for intelligence missions. The remotely piloted vehicle (RPV) will be a big player in the battle.

## IMPLICATIONS

### Mobility

The need for landing zones (LZs) is evident, along with all the traditional engineer support afforded the army and air force aviation components.

### Countermobility

Aviation will play a major role in the placing of aerially-delivered mines. The engineer will play a role in blocking enemy air routes with obstacles to air movement. These "aerial mines," in the sense of mines triggering wires or other obstacles to air movement, will be in wide use on the future battlefield.

### Other

In the areas of survivability and general engineering, we anticipate greatly increased requirements for aircraft shelters and other support facilities. The suppression of dust alone on tactical fields will be a major problem. For topography, increased air movement on the battlefield will impose requirements for command and control products depicting air-related terrain factors.

## AIR DEFENSE

### Trends and Implications

The support forward nature of the air defense mission will demand additional mobility support as long as they are not completely compatible in movement capability with the maneuver forces they support. This means access routes to the locations they typically favor for their mission: hill tops. A consideration for the future is the degree to which the air defense mission will continue on that battlefield. If aerial obstacle

mines become widely used on the battlefield, it implies that aerial movement itself will be degraded. It follows, then, that aerial operations may become obsolete, but this is considered unlikely.

## NBC

### Trends and Implications

On a battlefield where we are fighting in an NBC environment the key requirements for the engineer will be the provision of earthmoving support--for survivability--and obstacle clearance. Particularly this latter will be awesome in its proportions--and far beyond any capability the engineer has today.

## COMBAT SERVICE SUPPORT

### Trends

As we have discussed, there will undoubtedly be a need for more support on the future battlefield, stemming from more complex equipment, more use of tube-delivered munitions--both artillery and mines--and more prepositioning needs--for both strategic reasons as well as the deep strike tactical maneuver. Forward area refueling and rearming points will be critical--and will req ire combat engineer support. Longer LOCs are a certainty of AirLand doctrine, with forces operating further apart from one another and deep into the enemy area. There will be significant damage and disruption to rear area operations--the engineer requirements for support here will be enormous.

## IMPLICATIONS

### Mobility

LOC work will be critical, stemming from all the reasons noted above. There will be a significant need for countermine and counterobstacle support in the rear--Rear Area Combat Operations (RACO) will be heavy, and will tend to pull engineer support from the front.

### Survivability and General Engineering

The combat service support elements could by themselves consume all the engineer digging capability available. This will pose a tremendous problem for the theater commander to prioritize the users' needs. In the arena of general engineering, the construction requirements are going to tax the engineer resources sorely.

## COMMAND AND CONTROL, COMMUNICATIONS, AND INTELLIGENCE

### Trends

More and better is the undoubted direction for these elements of the battle--the "glue" as we laid out the factors of the battle. For Command and Control ($C^2$), there will be more agility, with more fluid boundaries, better routing of maneuver and movement, and overall better control of the battle--better management of time. Intelligence will benefit from the information processing revolution--the ability to collate and understand the millions of bits of data which fit together into some comprehensive picture. In this regard, we should outpace and retain the lead over the Soviets. Communications should have better security and more adequate flexibility in switching.

## IMPLICATIONS

### Mobility

Better $C^2$ will have obvious payoff to the engineer, decreasing the maneuver force's need for mobility support. Routes will be better known, through better intelligence, and the following of them will be more readily accomplished through positioning systems moving with the maneuver elements. The communicators will probably need more mobility support than currently is necessary, however, for they will be placing repeaters and other commo gear on remote sites.

### Countermobility

Command and control of our own scatter mines is a problem now and will continue into the future. Locating and reporting enemy mines will be a similar, if not bigger, problem. There will be a need for target-oriented obstacles to complement our enhanced speed and deny the enemy a similar advantage. Additionally, since the intelligence capability will be better capable of pinpointing the enemy location in "real-time," we need the enhanced munition delivery capability to take advantage of this improvement.

### Survivability

There is the chance that survivability will be enhanced through more movement, and thus the need for extensive digging obviated. However, the enemy will have an enhanced targeting ability, and this could offset the advantage. In fact, we must assume the need will grow.

### Topography

Lastly, topography. A key element for $C^2$ and intelligence. The implications are clear here. Topographers must automate and utilize the

digital processing capabilities already available. The information must be timely and accurate.

## IN SUMMARY

The salient fact of the review is that the engineer on the future battlefield will be even more necessary than he is today. The alteration of the ground to our advantage and the enemy's disadvantage becomes essential when we project the type of forces we shall have in the AirLand Battle 2000. That battlefield will be characterized by immense fires, large destruction on the ground, and derivatively difficult movement problems. The engineer will have to be dispersed; he--like the force he supports--will have to possess a high degree of endurance and agility: both quickness of mind and of movement.

### Mobility

The battlefield will be dense with obstacles, and in particular, aerial and artillery scattered mines of great destructive power. The force as a whole will need a total mobility for rapid maneuver and movement. Additionally the force will need strategic deployability--built into the force, for it certainly will not be built into the air carriers. Self-sustainment is demanded; the alternative is the impossible task of stockpiling in diverse areas at great cost with little guarantee of any future use. In sum, the engineer will need speed in moving and doing, strategic deployability, and survivability to do his tasks under fire. Of these, the most vexing is the problem of lightness--that is, building the materiel and supplies light, but yet preserving the needed power to do the job. Unfortunately, mechanical solutions won't work. Dozers, for example, which move the earth mechanically, are heavy. Therefore, we must develop explosives

which in turn are lighter and more powerful than they are today. Of the purely technical problems, by far the most insoluble remains--and will remain in 2000--the countermine detection riddle. While the enormous strides which will occur in command and control will provide help for the mobility problem through foretelling what may be passed rather than penetrated, the need for mobility on the future battlefield will remain preeminent.

Countermobility

The AirLand Battle requires deep thrust operations into enemy areas. Thus, it is apparent that we will need strong flank protective measures--measures to slow or stop the enemy's attempts to counterattack our force. Too, in the initial stages of the battle, it is essential that the enemy be delayed so that we may target and maneuver against him. For all this, the engineer is needed--more than ever. And, for the light force, he needs to be compatibly light--a tough requirement. One solution to this dilemma, at least in theory, is to do the job with explosives, not earthmovers. Explosives for these countermobility jobs need to be powerful and light--the technology is not here yet, but must be pursued. Additionally, a need made evident by our review is that for switchable, workable, dynamic obstacles--mines or other barriers: obstacles which can be turned on or off according to the commander's desire and which will provide the fine-tuned management of the battlefield required for successful execution of the AirLand tactics. The use of obscurants will have a significant affect on the battle--as we discussed, they could reduce the need for other protective measures, to include countermobility. But we feel the technologies of seeing will advance to compensate. Countermobility is crucial to the light force. Without it, or some other compensating factor, they cannot survive to win.

### Survivability

The need for survivability is most apparent in the light force, which must either move or be protected to maintain an advantage against heavier, more armored, troops. For the heavy force, survivability is key in the early battle, when we must survive to defeat the first echelon and go on to win. We are of the opinion that the requirements for this capability may override any other M-CM-S-GE&T need on the future battlefield. It is particularly important to the artillery and command and control assets. To provide survivability, engineers need speed in digging and light, strong, portable, and easily erectable shelters--shelters in the sense of the turtle's back. A difficulty, as has been noted before, is the provision of quick digging capability with light equipment.

### Topography

The clear need for topographic support in the future is that it be accurate and timely--no different from the requirements for it in the past, except that the time available will have drastically shrunk. Topographic data will be processed digitally. What is done in the field, vice what is done by the Defense Mapping Agency, needs to change, with only quick field updates performed in the theater.

### General Engineering

From the earlier discussion, we make the point that we must be prepared to fight on a global basis. The two somewhat alarming fallouts from this are the need for deployability--which means light forces--and the need for a built in sustainability. This latter is not easily attained. In a theater far removed from CONUS, the LOCs become tenuous, unreliable, and slow. How to support the force in a theater with little or no infrastructure--for example, Yemen as opposed to Germany? This vexing question leads

to only one one clear answer:  building, nurturing, and developing the construction and other technical capabilities in a country, or at least the region, before the need to enter the theater.  This may be done through the use of overseas contractors--American or not--in the areas of the world in which we have a potential interest.  In this fashion, the problems of host nation support are reduced, while at the same time building the capacity for this type of support within the country.

## CHAPTER II

## THE ENGINEER TODAY

### GENERAL

In this chapter, we shall attempt to describe realistically the current state of the art in combat engineering--in CSEMW terms. Engineer doctrine, organizations, training and materiel are evaluated against the backdrop of what is presently fielded, what is being practiced and what is coming off the shelf in the very near future (that is, through the POM years, FY 85-89). The observations stated herein provide the base case for comparison with the future implications outlined in Chapter I. From these "deltas" we can determine the expected shortfalls in capability to wage war effectively in the year 2000, and hence should be able to effect combat developments and doctrine to achieve better our aims at that point.

These observations were derived from a review of current topical studies such as the CSEMW MAA, the April 1981 M-CM-S SPR, and present draft and fielded doctrinal products. But, they are a product of the knowledge, experience and military professional judgment of the authors.

### DOCTRINE

#### General

With a few notable exceptions,the doctrine that exists today for combat engineers matches the available systems which support the mobility, countermobility, survivability, general engineering and topography (M-CM-S-GE&T) battlefield functions. This doctrine, however, has not changed

significantly from that of World War II. In closely looking at the status of engineer doctrine today, the following points can be made and some evolving changes can be gleaned:

- Engineer adaptations for The AirLand Battle and AirLand Battle 2000 are currently well in progress.
- Sharing of M-CM-S-GE&T tasks by combined arms teams is not now practiced.
- While combined arms training exercises generally include the divisional engineer battalions, other supporting engineer assets are normally not a part of these exercises.
- Engineer doctrinal products are outdated. FM 100-5 and other "How to Fight" manuals have made significant changes in battlefield requirements. Engineer doctrine needs to be updated to reflect Division and Corps 86 TO&Es as well as the new AirLand Battle doctrine. The principal engineer doctrinal manual, FM 5-100, "Engineer Combat Operations," was distributed to the field in coordinating draft on 26 May 1982. More detailed combat doctrinal manuals in the primary areas of Mobility (FM 5-101), Countermobility (FM 5-102), and Survivability (FM 5-103) are in development at the Engineer School. FM 5-34, "The Engineer Handbook," is an excellent reference for the individual and small unit leader, even though it is somewhat dated.
- Engineer doctrine which generally has four or five committed engineer battalions supporting each committed division appears to be somewhat mismatched with force structure (that is, there are not enough engineers available on the battlefield to accomplish all expected missions).

- There are some command and control problems doctrinally in managing engineer resources. The newly implemented "brigade engineer" concept will help alleviate this problem.

Mobility

Current countermine, counterobstacle and gap crossing doctrine needs to be reviewed to resolve issues concerning breaching, neutralizing, bypassing, speed, and location of engineers and their specialized equipment. Doctrinal combined arms team battle drill techniques for breaching minefields "in stride," for overcoming other man-made obstacles--tree blowdown and rubble--and for rapidly executing broad front gap crossing do not now exist, but should begin evolving as the new engineer doctrinal manuals are published. The doctrine for large scale river crossings is currently sound, and around mechanized and armored divisions is one of the most practiced battlefield tasks of the combat engineer. The doctrine for forward aviation combat engineering developed in Vietnam is generally good, but needs to be adapted for other environments.

Countermobility

The current doctrine for mine warfare is incomplete, due in a large degree to the systems of dynamic mines being created and fielded. This problem is being addressed by several groups and should be adequately resolved in the near term. Countermobility doctrine is sound at least for the initial preplanned phases of a defensive war. In a fluid, more mobile battlefield, the doctrine for the destruction of "key" or critical structures such as a Remagen Bridge, is probably the weakest link. The present doctrine on the employment and use of Atomic Demolition Munitions (ADMs) also needs to be reviewed.

## Survivability

The importance of "digging in" and providing protection to systems and soldiers has been continually underestimated. The magnitude of the requirement versus the small number of systems available to dig makes the survivability concepts and doctrine extremely important. What is really needed is a doctrinal allocation of scarce resources. The current doctrine on fighting positions and protective emplacements and protected support facilities is good while the doctrine on camouflage and deception is inadequate.

## General Engineering

Most doctrine related to this engineer battlefield function is adequate, but in practice there will again have to be an allocation of scarce resources. The implementation of general engineering doctrine will require intelligent, innovative commanders and excellent command and control. The two areas that currently need resolution are the clearing of mines (probably dynamic in the rear areas) and the requirement for rapid runway repair of air force airfields.

## Topography

The most significant problem with current topography doctrine is that of who should be the prime producer of topographic products and who should perform the mission. Defense Mapping Agency provides backup capability, but should probably do all, except for minor field revisions. Large topographic field units could be eliminated and whether this should be done should be determined from a doctrinal review. An additional problem with topography doctrine is the present system for requisition, storage and distribution of standard topographic products. The tasks are divided between the Engineers and the Quartermaster Corps. This should be resolved and maps should become a standard item of supply.

## Other

There are two other doctrinal areas not related to the above enumerated battlefield functions that need to be addressed. The first is the maintenance structure that will support the engineer operations on the battlefield. The low density and many different engineer units and equipment exacerbates this problem. The second problem is the marginal ability to support logistically engineer operations with the required Class IV and Class V materiel.

## ORGANIZATIONS

Fundamentally, engineer organizations of today are little changed from the World War II period, and current trends do not point to significant change in the short term. Key concepts and trends include:

- Retention of the divisional engineer battalion concept with all engineer assets organic to the division consolidated in the one battalion.
- Mechanization (M113 APCs) of critical, forward-supporting corps combat engineer battalions in the heavy force.
- Evolution of the brigade staff engineer concept toward a small cell which joins and works with the maneuver brigade operations and plans section.
- Creation of an engineer support platoon in all line companies to manage better the supporting sections and help control newly developed mobility/countermobility elements.
- Continuation of tailored organizations to support the three fundamentally different types of divisions (heavy, light, and airborne/air assault).

- Limited growth in size of divisional battalions--mostly to man equipment or functions transferred into the battalions such as the AVLB consolidation.
- Overall engineer end strength generally stable with greater than 70% of the force in the reserve components. Personnel to man additional/new equipment will largely be resourced from reductions in other engineer organizations.

## Mobility

Short term organizational changes will have little overall effect on the mobility of engineer units save for the added command and control problems associated with employment of all of the division's AVLB assets. Creation of the brigade staff engineer cell however, should improve the quality and timeliness of engineer mobility support as well as advice to the brigade commander on terrain and obstacles. In the short war scenario, scarcity of active and forward deployed corps engineer units will degrade the force's capability to reduce obstacles.

## Countermobility

With the exception of heavy divisional engineer battalions and limited conversions to mechanized configurations in some Europe based corps combat battalions, engineers expected to perform countermobility missions in forward areas may not survive and therefore may not be able to accomplish their missions. Limited airborne/air assault engineer forces at corps level may limit the capability of the rapid deploying light forces to counter sufficiently the enemy's mobility.

## Survivability

Limited active and forward deployed engineer force structure will require command decision on allocation of scarce resources. As a consequence, survivability support to rear area forces (especially logistics elements) and airborne rapid deployment forces will be marginal to nonexistent.

## General Engineering

Accomplishment of general engineering missions will be a function of the priority of the missions and the availability of engineer forces in the battle area to accomplish them. Many critical rear area missions are in jeopardy of not being done timely or well such as airfield repair and rear obstacle reduction, due to a lack of engineer forces. Compounding the force structure problems are the doctrinal problems of who or what organization will be tasked to do the work: combat heavy engineer battalions, air force, or host nation support?

## Topography

Present quick support comes from recently fielded terrain analysis detachments which must be doctrinally fixed for command and control relationships. Topographic products however, generally come from echelons above corps (EAC) which are not sufficiently responsive to the battle commander's timely needs.

## Other

Engineer command, control and communications at division level are ill-suited today to respond to the challenges of the AirLand Battle. Given the present small assistant division engineer (ADE) organization, and complicated by the volume and complexity of the information they are expected

to receive through overloaded communications systems, it is unlikely that this cell will be able to provide timely and responsive support. At the unit level, engineer maintenance elements are seldom capable of adequately maintaining the diverse, complex engineer equipment in peacetime--the added stress of battle is certain to defeat this structure.

## TRAINING

### General

Engineer training operations with the combined arms team are inherently costly, dangerous and are environmentally destructive; therefore engineer training missions are often simulated. These simulations, especially during FTX's, often give a misleading impression to the maneuver unit commander as to the full value of the engineers' contribution to battle outcome, and mislead him to conclude that he can get by with as few or less engineers than he has. Other characteristics of engineer training today include:

- Habitual combined arms training with only divisional engineer units. Corps combat and combat heavy battalions normally get involved with maneuver units only on infrequent FTX's.
- Standardized "crew drills" as per TM's on bridging erection, hand minefield emplacement/clearing/marking, CEV gunnery, tank ditching, and others. Note that the vast majority of this type of training is done just by engineers and not in the combined arms mode.
- Very few established and practiced "battle drills" with other members of the combined arms team, except possibly for gap and river crossings where engineer capabilities and coordination are absolutely critical to mission success.

- Much small unit and individual training in problem-solving where reliance is heavy on junior leaders; for example, route reconnaissance, expedient gap crossing, obstacle construction and removal, combat trails and roads. Again, the majority of this type of training is practiced only by the engineers, even though many of the skills are needed by other arms.
- Utilization of training aids and simulations.

  - mostly inert, passive devices to simulate mines
  - much simulation of obstacle and fighting position construction (especially during FTX's) where destruction of terrain and facilities is deemed environmentally or economically too costly
  - much simulation of the logistics aspects of Class II and IV, and Class V (this occurs for example in the issue from ASP's and depot stocks, transportation haul and so forth)
- War game simulations.

  - engineer play/impact is minimal or nonexistent in most current games
  - where engineer capabilities are played, there is no commonly acceptable data base to portray results
- Little to no training in common engineer tasks of non-engineer soldiers.

  - Rudimentary mine detection/recognition techniques are taught to all soldiers during basic training, but nothing on removal or clearing beyond the simplest hand techniques
  - Local efforts are often made to train specialized teams, such as scouts, on demolition techniques, mine detection, mine-

field installation and marking, and similar high profile engineer skills, but there are no directive efforts in these endeavors

- A profusion of missions--combat/general engineering, fight as infantry--assigned to engineer units often dilute their capability to become highly proficient in any single function.
- Loose assignment of engineer terrain detachments resulting in little to no coordination with combat engineer units.

Mobility

Mobility training to overcome natural obstacles is practiced fairly well today, especially in major FTX's. A major weakness, however, lies in the training of all combined arms elements to breach and pass through complex obstacles such as those generated by a strongly defending enemy force. Without protection or standoff neutralization systems, survivability of even a well trained engineer force is doubtful when breaching under fire is attempted. Except for mechanized engineer elements in divisional battalions, poor engineer cross country mobility and self protection will not permit most engineers to move up front in stride with the supported combat units. Rear area and logistics support units will be stymied by obstacles in their area of operations until engineer units can be brought on site to breach for them, or until they can be trained in breaching techniques.

Countermobility

Realism in training is key to representing the battlefield accurately to attacking units who customarily "bypass" or run through simulated obstacles both on field and simulation exercises (war games). Present reporting and recording systems simply do not work sufficiently well to be effective

in battle; training is but a small part of this problem, but its practice occupies a great deal of command and control effort on exercises.

Survivability

Realism is again key and means are not presently available to assess casualties on protected versus unprotected soldiers and equipment during training. The MILES system is a step in the right direction, but much remains to be done to simulate more of the destructive effects of battle on men and equipment--and to convince soldiers of the value of taking steps to make themselves more survivable.

General Engineering

This is probably the area where engineer training and its products are most evident to the maneuver commander. However, in actual combat, many of these general engineering functions which are performed as priorities during peacetime exercises may not be accomplished in war due to battle priorities and scarcity of engineer effort.

Topography

Highly centralized topographic support today generally removes it from consideration by the field commander as one of his assets; thus it is seldom played. Engineer terrain detachments are impacting on divisional level planning, and merely need to be lashed together more tightly with higher topographic units and engineer combat battalions.

Other

To remain proficient in their "reorganize as infantry" role, engineer units need to practice this more, especially on FTX's.

## MATERIEL

### General

From the outset of the discussion of the current status of engineer equipment several key points must be made:

- o More than any other combat or combat support unit, the engineers have the greatest diversity and variety of missions.
- o Most engineer missions are equipment and logistics intensive.
- o It is extremely difficult to design engineer systems that are capable of effectively accomplishing every mission for which they were designed over the entire spectrum of global terrain and weather.
- o Apart from mines, none of the engineer systems are designed to kill; therefore they normally occupy a much lower profile and priority than other combined arms systems which kill or disable things.
- o Many engineer systems are equivalent to commercial civilian systems because they accomplish very similar functions, albeit in different environments and under dissimilar conditions.
- o After a slowdown of almost fifteen years, new items of engineer-related equipment are now being procured. These new items of equipment will significantly enhance the combat engineer's capabilities on the modern battlefield.
- o There will be some reduction of different types of equipment in the divisional engineer battalion, such as graders, but these advantages will be offset by new items being added and by the move to consolidate all AVLB's with the divisional engineers.

Mobility

- o There will be significant improvement in forward area mobility with the projected buy of the ACE (Armored Combat Earthmover) and the expected equipping of some corps combat battalion with M113's.
- o Overall, however, there will be in the short term little increase in the mobility and survivability of the majority of the combat engineers' equipment.
- o The product-improved five ton truck will remain as the main transportation (troop and supply carrier) for most engineer battalions for the short term and for many years to come.
- o Generally, bridging is the one area which is in excellent shape overall when compared to the other combat engineers' materiel needs. The ribbon bridge will continue to be the primary equipment used to span major water gaps and it will continue to replace the MAB (Mobile Assault Bridge). This may be an area that requires relooking, as the MAB is currently our only true assault raft and bridge capability that is able to move under its own power. The majority of bridging which will be available in depot war reserve stocks will continue to be the Class 60, M4T6, and Bailey bridges. The Medium Girder Bridge (MGB) will continue to be available in limited quantities.
- o There is currently a deficiency for which there is no near term solution and that is for a Light Assault Bridge (LAB) to accompany the light division.
- o The Armored Vehicle Launched Bridge (AVLB) will continue to be the equipment used to span short wet and dry gaps in the heavy division. As units convert to M1 tanks, carrier parts are

likely to become more a problem than they are today when we have commonality of chassis.

- The hand held portable mine detector is currently the only mine detection capability available to the force. The inadequate ability to detect, with speed and operator survivability, to neutralize, and to mark enemy minefields is the most serious deficiency currently in the mobility area. For that matter, it is the most serious deficiency in the whole arena of combat engineering. Especially critical is the well-documented need for a stand-off mine detection capability. Detection by contact with rollers or plows mounted on tanks is currently the fastest method of breaching minefields, but few rollers or plows exist in the force, and most are reluctant to degrade their speed by carrying them. Also, available in small quantities are the two demolition projection charges.
- The Armored Combat Earthmover (ACE) helps improve the mobility of both the combined arms force and their combat engineers. The ACE will greatly assist in all mobility and survivability tasks.
- The Combat Engineer Vehicle (CEV) and Armored Combat Earthmover (ACE) are the primary counterobstacle vehicles, but the limited numbers of each throughout the battlefield diminishes their overall contribution to winning. There is a need for a powerful Counterobstacle Vehicle (COV) that can clear obstacles under fire rapidly and move in stride with the maneuver force.
- Dozers, scoop loaders, and scrapers will continue to be employed in large numbers to perform the combat roads and trails and

forward aviation combat engineering functions. There will still be too many dozers and other pieces of equipment on lowboys which means that most of the engineer systems will not have the mobility or survivability comparable to the maneuver force. This will be particularly true of other than divisional engineer battalions.

Countermobility

The Ground Emplaced Mine Scattering System (GEMSS) system will significantly improve the ability of combat engineers rapidly to emplace minefields in the forward areas.

- The entire family of dynamic mines has given a technological leap to the area of countermobility. It appears that there will be an abundance of these mines and delivery systems in the very short term.
- The M180 cratering charge has reduced the time required to emplace the standard road crater but there is still a need for improved explosives--lighter, safer, more powerful--to create obstacles.
- The Atomic Demolition Munition (ADM) is an anomaly on the battlefield. There is probably little chance of its use; therefore there is a current deficiency in our ability to create large explosive obstacles.

Survivability

This area has been improved considerably with the addition of the ACE to the engineer equipment inventory.

- The D7/8 dozers, scoop loaders and the JD410 backhoes along with the newly introduced ACE are the primary survivability systems.
- There is a definite need for a small mobile digger to replace the JD410. The small emplacement excavator (SEE) is badly needed to replace the JD410 now.

General Engineering

- The new multi-year buy of construction equipment will replace old and aging equipment and will significantly improve our capability.
- The multiplicity of makes and models of construction equipment causes difficulty in maintenance and cross-training for engineers; this problem is expected to ease as the new construction equipment comes into the inventory. This new equipment will still be in use in the year 2000.

Topography

- The current most pressing need in topography is for quick and accurate terrain analysis equipment using the enormous benefits to be derived from digital processing technology. We need a quick reproduction and updating capability in the field. The technology exists now, and the Defense Mapping Agency can furnish the needed inputs.

In summary, the most significant changes in engineer equipment during this century came during World War II; changes since then have been minimal. The biggest improvement has been in wet gap bridging where the time and manpower to construct combat bridging has been reduced and the bridging

capability increased. There appears to be significant effort in the countermine R&D area, but nothing emerges. As noted in Chapter I, it is our view *that not* much will appear—at least in detection--by the year 2000. On balance, the ACE and dynamic mines will make great contributions to the combat engineer's ability to support the battle commander.

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